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Effect of *Rotylenchulus reniformis* survival on nematode management in ornamental nurseries of southern Florida.

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INTRODUCTION: The reniform nematode *(Rotylenchulus reniformis* Linford and Oliveira) occurs commonly in southern Florida, where it damages vegetable and field crops (7). Yield losses of 10% are reported in infested fields of snap bean and squash in this part of the state (7). In Florida, the reniform nematode has regulatory importance, especially in the ornamental industry, because ornamental stocks contaminated with *R. reniformis* are rejected by Arizona and California with serious adverse economic impact for the Florida growers. Ornamental palms are grown intensively in southern Florida (Dade County) due to the favorable environmental conditions that exist in this part of the state for the production of these plants. Ornamental palms are particularly subject to the indirect damage caused by the reniform nematode because they are often grown in soil infested with this pest. For regulatory purposes, palms contaminated with reniform nematodes are considered infected regardless of their host status to the nematode. Recent host-range studies conducted by the Division of Plant Industry and the University of Florida using nine ornamental palms and one cycad have indicated that the most common palms grown in Florida are not hosts of the reniform nematode (5). In those tests, only the *Washingtonia robusta* palm was found infected by *R. reniformis* which did not induce obvious aboveground symptoms on this host (Fig. 1) (5).

Fig. 1. *Washingtonia robusta* infected by *Rotylenchulus reniformis*. Scale bars = 26 cm in A and 135 µm in B. A) Infected plant in pot. Note absence of aboveground symptoms. B) Nematode swollen female (N) with the posterior portion of the body protruding from the surface of a root.

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Reniform nematode densities in the soil with nonhost palms decreased drastically from the initial inoculum level of 4 nematodes/cc soil and persisted at a detectable level of <1 nematode/cc soil for 13 months (5). Further studies have shown that these residual nematode densities remained virulent after 16 months and were able to initiate infection and reproduction on a good host, black-eyed pea (*Vigna unguiculata* cv. California 5) when it was planted in soil removed from the palms (Table 1). These results indicate that *R. reniformis* has very long survival in marl soils of southern Florida in the absence of a host and cannot be eradicated by starvation in a reasonable length of time.

Table 1. Results of a bioassay with black-eyed pea (*Vigna unguiculata*) exposed to residual populations of *Rotylenchulus reniformis* surviving in soil planted with selected palms and a sago palm for 16 months. Black-eyed pea was grown for 90 days in soil after palm experiment.†

Palm species	Initial populations before bioassay (=residual population following palms) (Nematodes/cc soil)	Final populations following black-eyed pea bioassay
Arecastrum romanzoffianum	0.1*	6.7
Bismarckia nobilis	0.4*	13.8
Chamaerops humilis	0.3*	9.7
Coccothrinax sp.	0.1*	18.7
Neodypsis decaryi	0.2*	8.0
Phoenix roebelenii	0.3*	18.3
Ptychosperma elegans	0.3*	8.5
Ravenea rivularis	0.4*	15.4
*Washingtonia robusta***	2.5	31.3
Cycas revoluta	0.2*	13.2

†Ornamental palms and the cycad were kindly provided by Mr. J. Miller, Botanics Nursery, Homestead, Florida.
*Nematode survivors on nonhost palms from initial soil infestation of 4 nematodes/cc soil.
**Palm host of the reniform nematode.

MECHANISMS OF RENIFORM NEMATODE SURVIVAL: Several plant-parasitic nematodes are able to survive in soil and plant tissues for long periods of time in the absence of food sources by utilizing food reserves stored in their bodies as carbohydrates and fats (9). Juveniles and vermiform adults of *R. reniformis* have the ability to survive in a coiled and anhydrobiotic state for 25-27 months (2,8). Recent studies have shown that these nematode life stages survive adverse conditions in the absence of a host by utilizing food reserves and especially by reducing body water loss. The retention of molted cuticles of previous juvenile stages by *R. reniformis* vermiform adults (Fig. 2) plays an important role in regulating their body water content (2). These molted cuticles encase and protect the nematode body (Fig. 2). Because other *Rotylenchulus* species retain the cuticles as vermiform adults (6), it seems that this survival mechanism is a prerequisite common not only to *R. reniformis*, but to other species of the genus. Soil moisture and temperature influence also the survival of reniform nematodes. Moist soils (<1 bar) favor nematode survival at 25 C (77 F) but not at temperatures below freezing, whereas dry soils (> 15 bars) favor nematode survival at temperatures below freezing but not at 25 C (77 F) (3).

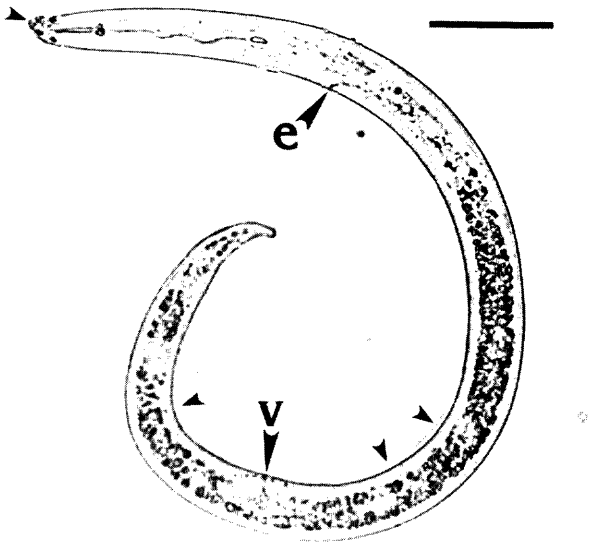

Fig. 2. *Rotylenchulus reniformis* vermiform female enclosed in the cuticles of juvenile stages (small arrows). e = excretory pore; v = vulva. Scale bar = 33.4 µm.

NEMATODE MANAGEMENT IN PALM NURSERIES. In southern Florida, ornamental palms are grown in containers or directly in the ground. In both cases, any attempt to eradicate the nematode from infested sites is complicated by the long survival of *R. reniformis*. The use of chemical control methods in nurseries with established ornamental palms does not meet the requirements for California certification. Furthermore, the few nonvolatile and nonphytotoxic nematicides registered for nematode control in ornamental nurseries (1) do not eradicate *R. reniformis* from infested sites. In infested nurseries cultural control practices, such as removal of weed hosts of the nematode (4.), interdiction of ornamental hosts (5), and protection from nematode contamination from other infested sources suppress nematode densities but do not eradicate the parasite due to its long survival.

Cleaning nematode-contaminated bare root palms before transplanting into uninfested soil in clean containers is a good practice, but it is expensive, especially for large palms, and it is not economically feasible for all operations. If root balls are not completely cleaned, contaminating nematodes can remain in the soil particles tightly adhering to the roots, nullifying the effectiveness of this method. The best approach is the adoption of guidelines that meet the requirements of reniform nematode quarantine regulations, which include, from the beginning, the use of clean plants in noncontaminated soil and in containers placed on raised benches or on approved concrete slabs not in direct contact with the ground, rather than cleaning the plants up later. These good sanitation practices and the implementation of procedures that prevent nematode contamination from other sources remain the best practical means, at present, of managing *R. reniformis* in nurseries marketing their palms to areas with restrictive quarantines.

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